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EC PULMONOLOGY AND RESPIRATORY MEDICINE

Research Article

Prevalence of Chronic Respiratory Symptoms among a Population with Non-obstructive Lung Function (Forced Expiratory Ratio ≥ 70%) in Nigeria

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Received: February 16, 2019; **Published:** April 12, 2019

Abstract

Background: While chronic pulmonary symptoms are commonly reported, data on their prevalence across countries and burden in affected individuals, especially in those with normal lung function, are limited. This study was conducted with contemplation that its outcome would provide worthwhile information to taper the current lacuna in available data on the prevalence of chronic lung symptoms among an apparently healthy population with normal lung functions in Nigeria.

Methods: This cross-sectional study was conducted in a semi-urban settlement among apparently healthy residents with non-obstructive lung function (FEV_1/FVC ≥ 70%). The data on respiratory symptoms was collected with a survey tool adapted from British medical research council questionnaire on respiratory symptoms. Data was analyzed with SPSS version 22, Odds ratio was applied to express the magnitude of associations between respiratory symptoms and demographic indices as well as exposure to pollutants and corrected with logistic regression where applicable.

Results: Females were just under three-fifths (59.3%). Males were three times more likely than females to have occupational exposure to dust, irritant gas or chemical, 4.13 (1.13 - 15.02).

The most prevalent (16.1%) respiratory symptom was breathlessness (dyspnea) followed by wheeze (8.1%), chronic cough (4.8%), prolonged expectoration (4.0%), chronic mucus hyper- secretion (3.2%) and chest tightness (2.0%). The prevalence of prolonged cough was three-fold higher among biomass users, [OR = 4.13 (1.21 - 14.07)]; more distinctly males were over 6 times as likely as females to chronically produce sputum [OR = 6.24 (1.30 - 29.84)]. The prevalence of prolonged cough and expectoration as well as wheeze predominated in the middle-aged, p = 0.002, 0.010, 0.001 respectively. Work-related exposure to dust, irritant gas or chemical was associated with a four-fold higher likelihood for chronic cough [OR = 5.04 (1.03 - 24.78)]. However, no symptom retained a significant association with predictors after adjustment.

Conclusion: As the occurrence of chronic respiratory symptoms among this population was not hinged on any factor, instituting early diagnosis and prompt treatment would be beneficial to them in order to forestall a decline in their lung function.

Keywords: *Chronic Respiratory Symptoms; Lung Function*

Introduction

Persistent exposure to noxious air-borne chemicals could invariably lead to an impingement in the respiratory function of the exposed individuals [1,2]. Nonetheless, it is not impossible for populations to have somewhat intact lung function while recurrent respiratory symptoms or even disease is present [3]. The report on the global strategy for the diagnosis, management, and prevention of chronic

obstructive pulmonary disease (COPD) states that persons with respiratory symptoms such as chronic cough and sputum production are at risk of COPD, although not all develop airflow obstruction [4]. For instance, long-standing smokers may have apparently normal lung function even if they have chronic respiratory symptoms [5]; simply because Forced Expiratory Ratio is unresponsive to subtle changes in the early stage of respiratory disease [6].

Globally, one of the most important risk factors for respirational symptoms and disorders is environmental tobacco smoking [7,8]. Environmental pollution such as indoor-air pollution arising from biomass fuel is also a significant risk factor for the development of COPD, especially in underdeveloped nations, including Nigeria [8,9]. Several studies conducted in South America, Asia, and Africa prove that persons exposed to wood smoke have an increased risk for lung diseases [10-12]. Documented evidence has also confirmed that exposure to occupational pollutants such as dust, gases, and fumes is not unrelated to the development of chronic pulmonary diseases [13-15]. Such is the reality in Nigeria, where a recent study recorded a high prevalence of chronic cough, wheeze, breathlessness and chest tightness among workers exposed to wood smoke from wood-burning earth kilns and a different study described accentuated risk of pulmonary ailment amongst workers with a related exposure [16,17]. Furthermore, construction- as well as traffic-related activities in Africa are also sources of pollutants which potentiate the development of respiratory symptoms in individuals [18,19].

From the preceding, therefore, it is recognizable that occupational and non-occupational exposure to irritants is a predisposing factor to COPD [20]. COPD accounts for the third highest cause of death internationally [9,21]. The financial burden of COPD worldwide is US$2.1 trillion, with a high socio-economic burden and a deleterious effect on the quality of life of its sufferers [9,22]. Currently, the COPD-associated mortality and morbidity rate is increasing, especially in Asian and African Countries, mostly as a consequence of a progressive rise in the prevalence of smoking [22,23]. In Africa, COPD-related deaths estimated about two decades earlier was 18.1 per 100,000 population, and the current figures could be much higher [24]. In low and middle-income nations such as Nigeria, COPD is also one of the 10 leading causes of death [25]; and owing to the slow progression of the disease, its toll will continue for several decades without prompt intervention [23].

While chronic pulmonary symptoms are commonly reported, data on their prevalence across countries and burden in affected individuals, especially in those with normal lung function, are limited [9,26]. This study was conducted with contemplation that its outcome would provide worthwhile information to taper the current lacuna in available data on the prevalence of chronic lung symptoms among an apparently healthy population with normal lung functions in Nigeria. Thus, this study was designed to investigate if residents with normal lung functions in a semi-urban community in Delta State, have chronic respiratory symptoms. Chronic respiratory disorders, due to their chronicity and protracted evolution, could be prevented if symptoms are promptly detected before any significant affectation of lung function become apparent [23].

Methods

Study area, design and population

By adopting a cross-sectional design, this study was conducted to assess the prevalence of respiratory symptoms among seemingly healthy residents in Sapele, Delta State, Nigeria.

Selection criteria

The study included only adult (18years and older) residents who willingly consented to participate in the study. Residents who had diagnostically confirmed lung disorders or history of Pneumonia, Tuberculosis, and asthma were excluded.

Sampling technique

From a designated central location a bottle was spun to decide the starting point for sampling in the metropolis. The first house of the selected street was chosen and all adults who willingly gave consent to participate in the study were recruited. A simple random sampling

technique with a table of randomized numbers was applied to choose subsequent houses in a clockwise direction until the minimum sample size was attained.

Ethical approval

This study was approved by the Health Research Ethics Committee at Delta State University Teaching Hospital. The whole essence and finer points (procedure) of the study were vividly explained to the participants, following which written informed consent was obtained from each of them who voluntarily took part in the study.

Procedure

Preliminary phase

This was an initial assessment of potential respondents to determine eligible participants with normal lung function, however informed consent was sought from all partakers during this phase. A portable spirometer contrived by Micro Medical, Ltd., Kent, UK was applied in accordance with the American Thoracic Society and European Respiratory Society Joint Task Force Guidelines on Spirometry to measure forced expiratory ratio [Forced Expiratory Volume in the first second (FEV_1) divided by Forced Vital Capacity (FVC) - FEV_1/FVC] [21]. Spirometry was performed prior to and just after administration of a bronchodilator. An Inhaler containing short-acting beta-receptor agonist (Salbutamol) was administered with disposable mouthpieces 15-20 minutes before a repeat test. Reversibility was said to be present in an individual if their FEV_1/FVC ratio improved by 12% or more and FEV_1 increased up to 200 ml. Only participants with unobstructed lung function defined as FEV_1/FVC ≥ 70% eventually got recruited for an interview.

Actual data collection

Information on respiratory symptoms was collected with a survey tool adapted from British medical research council questionnaire on respiratory symptoms [20]. Chronic mucus hyper-secretion is cough productive of mucus lasting up to three months per year for at least two consecutive years.

Statistical analysis

Data was analyzed with Statistical Package for Social Sciences (SPSS) version 22 (IBM Corp., Armonk NY, USA). Age group was classified as follows: young ≤ 40 years and older adults (middle-aged and elderly) > 40 years. The primary outcome measure was the prevalence of chronic respiratory symptoms; the secondary outcome measure was the association between the prevalence of chronic respiratory and potential determinants. Prevalence of chronic respiratory symptoms was presented in percentages, while continuous variables in means (± standard deviations). Chi-square and odds ratio compared proportions and estimated the associations between the prevalence of chronic respiratory symptoms and exposure. Logistic regression analysis was done for only variables with significant crude odds ratio.

Results

Females were more than males with a male to female ratio of 2:3; the study participants were predominantly young people (67.8%) with just less than a third (32.3%) constituting middle-age and elderly. Males were apparently younger than females by 9.97 years although, generally, the average age was 37.70 years. While over half (56.0%) of all study participants had secondary education more than three-fifths (65.7%) and one-tenth (10.6%) of males had second- and third- level education respectively. Additionally, males were four times as likely females to have occupational exposure to dust, irritant gas or chemical, OR = 4.13 (1.13 - 15.02). A greater proportion of males than females (34.3% versus 32.0%) burn biomass at home. Males were virtually twice more likely than females to be smokers [OR = 3.08 (0.95 -9.99)].

Variables	Categories	Frequency (%)		
		Male (n = 101)	Female (n = 147)	Total (N = 248)
Age groups	Young	90 (89.1)	61 (41.5)	151 (67.8)
	Older adults	11 (10.9)	86 (58.5)	97 (32.2)
	OR (95% CI)	11.54 (5.71 - 23.31)		
	Mean age (± SD)	31.79 ± 10.75	41.76 ± 14.12	37.70 ± 13.74
	MD (95% CI)	-9.97 [-13.24 to (-6.70)]		
Education	None	14 (13.9)	24 (16.3)	38 (15.3)
	Primary	10 (9.9)	42 (28.6)	52 (21.0)
	Secondary	66 (65.3)	73 (49.7)	139 (56.0)
	Tertiary	11 (10.8)	8 (5.4)	19 (7.7)
		χ^2 =15.139	p = 0.002	
Occupational exposure to irritant gas or dust	Yes	8 (7.9)	3 (2.0)	11 (4.4)
	No	93 (92.1)	144 (98.0)	237 (95.6)
	OR (95% CI)	4.13 (1.13 - 15.02)		
Biomass	Users	38 (34.3)	47 (32.0)	85 (34.3)
	Non-users	63 (65.7)	100 (68.0)	163 (65.7)
	OR (95% CI)	1.28 (0.76 - 2.18)		
Smoking	Yes	8 (4.8)	4 (2.7)	12 (4.8)
	No	93 (95.2)	143 (97.3)	236 (95.2)
	OR (95% CI)	3.08 (0.95 - 9.99)		

Table 1*: Socio-demographic characteristics.*

MD: Difference between mean ages of male and female; CI: Confidence Interval; Older Adults: Middle-Aged and Elderly.

Breathlessness (16.1%) was the most prevalent respiratory symptom and chest tightness was the least common. While the prevalence of chronic cough and expectoration were about the same (4.8% and 4.0%), almost a negligible proportion (3.2%) of the participants had chronic mucus hyper-secretion (Table 2).

Symptoms	Frequency (%)	
	Present	Absent
Prolonged cough	12 (4.8)	236 (95.2)
Chronic expectoration	10 (4.0)	238 (96.0)
Dyspnoea	40 (16.1)	208 (83.9)
Chest tightness	5 (2.0)	243 (98.0)
Wheeze	20 (8.1)	228 (91.9)
Chronic bronchitis (Chronic mucus hyper-secretion)	8 (3.2)	240 (96.8)

Table 2: *Prevalence of respiratory symptoms.*

Females were less likely than males to have prolonged cough as two-thirds of the study participants with this symptom were males. Similarly, but more distinctly males were 6 times as likely as females to chronically produce sputum. Dyspnea was also more prevalent among males although with a more precise confidence limit. As per chronic bronchitis, the male to female ratio was 7:1. Generally, respiratory symptoms predominated among the older adults with significantly distinct occurrence for prolonged cough and expectoration

as well as wheeze. Smokers appeared more susceptible to prolonged cough [OR = 4.52 (0.93 - 22.05)] while workers with work-related exposure to gas or dust actually had a four-fold higher likelihood to have a chronic cough, OR = 5.04 (1.03 - 24.78). In the same vein, the prevalence of prolonged cough was three-fold higher among biomass users [OR = 4.13 (1.21 - 14.07)].

Prevalence of respiratory symptoms Frequency (%)							
Variable	**Categories**	**Prolonged cough (n = 12)**	**Chronic expectoration (n = 10)**	**Dyspnoea (n = 40)**	**Chest tightness (n = 5)**	**Wheeze (n = 20)**	**Chronic bronchitis (CMH) (n = 8)**
Sex	Male	8 (66.7)	8 (80.0)	22 (55.0)	3 (60.0)	12 (60.0)	7 (87.5)
	Female	4 (33.3)	2 (20.0)	18 (45.0)	2 (40.0)	8 (40.0)	1 (12.5)
	OR (95% CI)	3.08 (0.90 - 10.45)	6.24 (1.30 - 29.84)	2.00 (1.00 - 3.24)	2.22 (0.37 - 13.43)	2.34 (0.92 - 5.93)	10.87 (1.33 - 89.11)
Age group	Young	2 (16.7)	2 (20.0)	1 (16.7)	3 (75.0)	5 (25.0)	2 (25.0)
	Older adults	10 (83.3)	8 (80.0)	5 (83.3)	1 (25.0)	15 (75.0)	6 (75.0)
	OR (95% CI)	8.56 (1.84 - 39.76)	6.70 (1.40 - 32.05)	8.15 (0.95 - 70.32)	0.05 (0.05 - 4.96)	5.34 (1.88 - 15.17)	4.91 (0.98 - 24.70)

Table 3a: *Factors (Sex and Age) associated with Prevalence of respiratory symptoms.*

[LR]: Likelihood Ratio Chi-Square.

Prevalence of respiratory symptoms Frequency (%)							
Variable	**Categories**	**Prolonged cough (n = 12)**	**Chronic expectoration (n = 10)**	**Dyspnoea (n = 40)**	**Chest tightness (n = 5)**	**Wheeze (n = 20)**	**Chronic bronchitis (CMH) (n = 8)**
Smoking	Yes	2 (16.7)	1 (10.0)	3 (7.5)	0 (0.0)	0 (0.0)	1 (12.5)
	No	10 (83.3)	9 (90.0)	37 (92.5)	5 (100.0)	20 (100.0)	7 (87.5)
	OR (95% CI)	4.52 (0.93 - 22.05)	0.46 (0.06 - 3.32)	0.63 (0.22 - 1.75)	N/A $p = 0.479^{LR}$	N/A $p = 0.150^{LR}$	0.36 (0.05 - 2.67)
Dust/ irritant gas exposure	Yes	2 (0.0)	0 (0.0)	2 (5.0)	1 (20.0)	1 (5.0)	1 (0.0)
	No	10 (100.0)	10 (100.0)	38 (95.0)	4 (80.0)	19 (95.0)	7 (100.0)
	OR (95% CI)	5.04 (1.03 - 24.78)	N/A $p = 0.336^{LR}$	1.16 (0.26 - 5.22)	5.83 (0.65 - 52.26)	1.20 (0.16 - 9.00)	1.15 (0.15 - 8.61)
Biomass users	Yes	8 (66.7)	5 (50.0)	12 (30.0)	4 (80.0)	9 (45.0)	4 (50.0)
	No	4 (33.3)	5 (50.0)	28 (70.0)	1 (20.0)	11 (55.0)	4 (50.0)
	OR (95% CI)	4.13 (1.21 - 14.07)	0.52 (1.55 - 1.75)	1.22 (0.65 - 2.27)	0.13 (0.02 - 1.15)	0.64 (0.28 - 1.48)	0.52 (0.13 - 2.03)

Table 3b*: Factors associated with Prevalence of respiratory symptoms.*

[LR]: Likelihood Ratio Chi-Square.

Biomass, age-group, and exposure to irritant gas or chemical/dust were significantly associated with a prolonged cough, whereas only sex was correspondingly associated with chronic bronchitis. However, after adjusting for the effect of potential confounders the association between symptoms and predictors was not significant.

Variables	Predictors	Crude odds ratio	P-value before adjusting	p-value	Adjusted odds ratio	95% C.I. for OR	
						Lower	Upper
Prolonged cough	Smoking	4.52	Not sig.	0.197	3.33	0.54	20.68
	Biomass use	4.13	Sig.	0.065	2.96	0.94	9.38
	Gas	5.04	Sig.	0.999	0.000	0.000	
Prolonged expectoration	Smoking	0.46	Not sig.	0.676	1.66	0.16	17.66
	Biomass use	0.52	Sig.	0.555	1.52	0.38	6.03
	Gas	N/A	Not sig.	0.999	0.000	0.000	
Dyspnoea	Smoking	0.63	Not sig	0.637	1.40	0.35	5.57
	Biomass use	1.22	Not sig	0.252	0.63	0.29	1.39
	Gas	1.16	Not sig	0.999	0.000	0.000	
Chronic bronchitis	Smoking	0.36	Not sig	0.298	4.19	0.28	62.41
	Biomass use	0.52	Not sig	0.351	2.07	0.45	9.52
	Gas	1.15	Not sig	0.999	0.000	0.000	
Wheeze	Biomass	0.64	Not sig.	0.392	1.53	0.58	4.09
	Smoking	N/A	Not sig.	0.999	0.000	0.000	
	Gas	1.20	Not sig.	0.858	1.23	0.13	11.70

Table 4a: *Likely predictors (Smoking, biomass, irritant gas) of respiratory symptoms.*

Sig. = Significant = p < 0.05; not sig. = Not Significant i.e. p ≥ 0.05; N/A: Not Applicable.

Variables	Predictors	Crude odds ratio	P-value before adjusting	p-value	Adjusted odds ratio	95% C.I. for OR	
						Lower	Upper
Prolonged cough	Sex	3.08	Not sig.	0.053	3.55	0.99	12.80
	Actual Age	N/A	N/A	0.683	0.98	0.90	1.07
	Age group	8.56	Sig.	0.474	0.39	0.03	5.17
Prolonged expectoration	Sex	6.24	Sig.	0.143	3.49	0.66	18.58
	Actual Age	N/A	N/A	0.328	0.94	0.84	1.06
	Age group	6.70	Sig.	0.605	0.49	0.03	7.54
Dyspnoea	Sex	2.00	Sig.	0.903	1.05	0.48	2.29
	Age	N/A	N/A	0.111	0.96	0.90	1.01
	Age group	8.15	Not sig	0.960	0.96	0.21	4.38
Chronic bronchitis	Sex	10.36	Sig.	0.999	0.000	0.000	
	Actual Age	N/A	N/A	0.421	0.95	0.84	1.07
	Age group	4.91	Not sig	0.924	0.86	0.03	21.46
Wheeze	Sex	2.34	Not sig.	0.595	1.33	0.46	3.81
	Actual age	N/A	N/A	0.092	0.94	0.87	1.01
	Age group	5.34	Sig.	0.434	2.31	0.28	18.76

Table 4b: *Likely predictors (sex and age) of respiratory symptoms.*

Sig. = Significant = p < 0.05; not sig. = Not Significant i.e. p ≥ 0.05; N/A: Not Applicable.

Discussion

In this study, we sought to estimate the prevalence of chronic respiratory symptoms. Overall, we found that females outnumbered males, although the vast majority of the study participants were young people, more of whom were males. While a direct reason for the preponderance of the young in this study is unclear, it is not unconnected with the sampling technique whereby each household served as a cluster and cluster effect could not be completely eliminated. Males were proportionately better educated than females probably because the practice of relegating education of the girl child is still rife in the community [27]. Education, amongst other socioeconomic factors, is a known contributor to improving health, thus, the women in this study may unwittingly be drawn towards certain health risks which are easily avoided by the enlightened [28]. However, occupational exposure to air pollutants or noxious substances was prevalent amongst males who were more than four times likely to have inadvertent contact with these particles. Males often ignorantly, and sometimes, knowingly take risks while making efforts to fend for themselves and their families– an assertion that is vividly exemplified by the actuality in resource-constrained settings such as Nigeria [29].

Exposure to smoke from biomass and cigarette was more popular among males. Although the rate of tobacco use has been reported to be higher among males [30-32], it is surprising to observe the same for biomass in this study. It is not implausible that the young men in this study assisted their mothers in the kitchen as most forms of domestic biomass combustion in the tropics are mainly for cooking meals [33,34], hence their higher exposure rates. Biomass and tobacco smoke are similar in properties and are responsible for a gamut of respiratory problems, most of which are incurable, and thus should be prevented [35].

Much less than one-fifth of the participants had breathlessness. Although this was the commonest respiratory symptom, approximately 1 in 25 participants had prolonged cough and expectoration separately; chest tightness and chronic bronchitis were less common. The prevalence of these symptoms suggests that people with $FEV_1/FVC \geq 70\%$ have lung-related ailments [36]; nonetheless much higher prevalence of cough and dyspnea have been recorded among individuals with normal spirometry [37], thus substantiating the fact that having normal lung function does not preclude people from having a respiratory illness.

Unlike this study where under one-fifth of smokers had a chronic cough, an earlier study recorded respiratory symptoms among half of the smokers with preserved respiratory function [5]. With more male smokers, this study recorded predominantly more respiratory symptoms among men, however, chronic expectoration, dyspnea and chronic bronchitis were the only significantly prevalent symptoms. In the same way, a recent study demonstrated an increased risk of cough, dyspnea, wheeze, and expectoration among smokers [38].

As an attempt to explore the possible etiologies of respiratory symptoms in this population it can be extrapolated that the dangers of cigarette smoking are not restricted to only smokers, as unsuspecting individuals in the background inhale the smoke exhaled by the smokers as well as that emitted directly from the cigarette. Besides, particulate matter from smoke can perch on household items, react with environmental oxidizing gases and generate other toxic chemicals which can be subsequently inhaled [39-41]. Just as passive smoking has its own deleterious effects on lung function and can induce respiratory symptoms, banning smoking in public places as well as restricting indoor smoking to secluded areas may address some of the issues related to exposure to tobacco smoke.

Nevertheless, after controlling for potential confounders of respiratory symptoms no variable remained a significant predictor, thus, sex, age, biomass use, and exposure to irritant chemicals or gas were likely confounders, rather than predictors of the prevalence of respiratory symptoms among the study population. The foregoing exemplifies the fact that people are at risk of respiratory symptoms regardless of their demographic characteristics and/or exposure factors [42]. Nonetheless, this study may have been underpowered to detect significant associations between the prevalence of respiratory symptoms and apparently linked factors, thus its limitation was its sample size. Although only a small proportion had symptoms with normal FEV_1/FVC, it may be suggested that these should be followed more closely in order for an intervention to be instituted before their lung function become defective.

Conclusion

Despite the high prevalence of respiratory symptoms, age, sex, biomass use and occupational exposure to pollutants were not valid determinants of the prevalence of symptoms among this population. Therefore, residents with` non-obstructive lung function invariably

have apparent manifestations of early respiratory disease and would ultimately benefit from early detection and prompt intervention before irreversible damage to their lung ensues.

Bibliography

1. Tanimowo MO. "Air pollution and respiratory health in africa: a review". *East African Medical Journal* 77.2 (2000): 71-75.

2. Isara AR and Aigbokhaode AQ. "Respiratory symptoms and pulmonary functions among masons and office workers in Benin city, Nigeria". *Journal of Medicine and Biomedical Research* 15.1 (2016): 121-130.

3. Mannino DM., *et al*. "Obstructive lung disease and low lung function in adults in the United States: data from the National Health and Nutrition Examination Survey,1984-1994". *Archives of Internal Medicine* 160.11 (2000): 1683-1689.

4. Huchon GJ., *et al*. "Chronic bronchitis among French adults: high prevalence and underdiagnosis". *European Respiratory Journal* 20.4 (2002): 806-812.

5. Woodruff PG., *et al*. "Clinical Significance of Symptoms in Smokers with Preserved Pulmonary Function". *New England Journal of Medicine* 374.19 (2016): 1811-1821.

6. Johns DP., *et al*. "Diagnosis and early detection of COPD using spirometry". *Journal of Thoracic Disease* 6.11 (2014): 1557-1569.

7. Hulin M., *et al*. "Respiratory health and indoor air pollutants based on quantitative exposure assessments". *European Respiratory Journal* 40.4 (2012): 1033-1045.

8. Brashier BB and Kodgule R. "Risk Factors and Pathophysiology of Chronic Obstructive Pulmonary Disease (COPD)". *Journal of the Association of Physicians of India* 60 (2012): 17-21.

9. Salvi S. "The silent epidemic of COPD in Africa". *Lancet Global Health* 3.1 (2015): e6-e7.

10. Regalado J., *et al*. "The effect of biomass burning on respiratory symptoms and lung function in rural Mexican women". *American Journal of Respiratory and Critical Care Medicine* 174.8 (2006): 901-905.

11. Desalu OO., *et al*. "Increased risk of respiratory symptoms and chronic bronchitis in women using biomass fuels in Nigeria". *Jornal Brasileiro de Pneumologia* 36.4 (2010): 441-446.

12. Kurmi O., *et al*. "Reduced lung function due to biomass smoke exposure in young adults in rural Nepal". *European Respiratory Journal* 41.1 (2013): 25-45.

13. Al-Naeimi YI., *et al*. "Respiratory illnesses and ventilatory function among workers at a cement factory in a rapidly developing country". *Journal of Occupational and Environmental Medicine* 51.6 (2001): 367-373.

14. Karkhanis VS and Joshi JM. "Combined pulmonary fibrosis and emphysema in a tyre industry worker". Lung India 29.3 (2012): 273-276.

15. Dienye P., *et al*. "Respiratory effects of biomass fuel combustion on rural fish smokers in a Nigerian fishing settlement: a case control study". *African Health Sciences* 16.2 (2016): 516-523.

16. Obiebi IP. "Factors Impinging on Lung Function Deficits and Respiratory symptoms among Workers at Wood-Burning Earth Kilns". *Theranostics of Respiratory and Skin Diseases* 1.1 (2018): 1-8.

17. Obiebi IP and Aiwuyo HO. "Exposure to Wood Smoke Accentuates Risk of Respiratory Diseases: A Case of Charcoal Workers in a Developing Nation, Sub-Saharan Africa". *EC Pulmonology and Respiratory Medicine* 7.6 (2018): 353-358.

18. Mbelambela EP., *et al*. "Occupation exposed to road-traffic emissions and respiratory health among Congolese transit workers, particularly bus conductors, in Kinshasa : a cross-sectional study". *Environmental Health and Preventive Medicine* 22 (2017): 11.

19. Jackson MM. "Assessment of air pollution in residential areas of Kinondoni municipality in Dar es Salaam City, Tanzania". *International Journal of Biological and Chemical Sciences* 3.4 (2009): 786-795.

20. Matheson MC., *et al*. "Biological dust exposure in the workplace is a risk factor for chronic obstructive pulmonary disease". *British Medical Journal* 60.8 (2005): 645-651.

21. Guerra S., *et al*. "Chronic bronchitis before age 50 years predicts incident airflow limitation and mortality risk". *Thorax* 64.10 (2009): 894-900.

22. Schellack N., *et al*. "An update on chronic obstructive pulmonary disease". *South African Family Practice* 58.3 (2016): 6-12.

23. World Health Organization. Chronic Respiratory Diseases. Geneva (2017).

24. Lopez AD., *et al*. "Global and regional burden of disease and risk factors: systematic analysis of population health data". *Lancet* 367.9524 (2006): 1747-1757.

25. Ko FW., *et al*. "Worldwide burden of COPD in high- and low-income countries". *International Journal of Tuberculosis and Lung Disease* 12.7 (2008): 713-717.

26. Menezes AMB., *et al*. "Chronic Bronchitis Phenotype in subjects with and without COPD: the PLATINO study". *European Respiratory Journal* 40.1 (2012): 28-36.

27. Tuwor T and Sossou M. "Gender discrimination and education in West Africa: Strategies for maintaining girls in school". *International Journal of Inclusive Education* 12.4 (2008): 363-379.

28. Hegewald MJ and Crapo RO. "Socioeconomic Status and Lung Function". *Chest* 132.5 (2007): 1608-1614.

29. Harris CR., *et al*. "Gender Differences in Risk Assessment: Why do Women Take Fewer Risks than Men?" *Judgment and Decision Making* 1.1 (2006): 48-63.

30. Chakraborty D., *et al*. "Indoor pollution from solid biomass fuel and rural health damage: A micro-environmental study in rural area of Burdwan, West Bengal". *International Journal of Sustainable Built Environment* 3.2 (2014): 262-271.

31. Adewole OO., *et al*. "Respiratory Symptoms and Lung Function Patterns in Workers Exposed to Wood Smoke and Cooking Oil Fumes (Mai Suya) in Nigeria". *Annals of Medical and Health Science Research* 3.1 (2013): 38-42.

32. Souza R., *et al*. "Respiratory symptoms in charcoal production workers in the cities of Lindolfo Collor, Ivoti and Presidente Lucena, Brazil". *Jornal Brasileiro de Pneumologia* 36.2 (2010): 210-217.

33. Sharath CB., *et al*. "Domestic Combustion of Biomass Fuels and Respiratory Symptoms Among Women of Sonatti Village, Belagavi-A Cross Sectional Study". *International Journal of Scientific Research* 41.6 (2016): 88-91.

34. Fullerton DG., *et al*. "Biomass fuel use and indoor air pollution in homes in Malawi". *Occupational and Environmental Medicine* 66.11 (2009): 777-783.

35. Moreira MA., *et al*. "Comparative study of respiratory symptoms and lung function alterations in patients with chronic obstructive pulmonary disease related to the exposure to wood and tobacco smoke". *Jornal Brasileiro de Pneumologia* 34.9 (2008): 667-674.

36. Regan EA., *et al*. "Clinical and radiologic disease in smokers with normal spirometry". *JAMA Internal Medicine* 175.9 (2015): 1539-1547.

37. Oppenheimer BW., *et al*. "Distal Airway Function in Symptomatic Subjects With Normal Spirometry Following World Trade Centre Dust Exposure". *Chest* 132.4 (2007): 1275-1282.

38. Ohar JA., *et al*. "Do symptoms predict COPD in smokers?" *British Thoracic Society* 137.6 (2010): 1345-1353.

39. DeCarlo PF., *et al*. "Thirdhand smoke uptake to aerosol particles in the indoor environment". *Science Advances* 4.5 (2018): e8368.

40. Jacob P., *et al*. "Thirdhand Smoke: New Evidence, Challenges, and Future Directions". *Chemical Research in Toxicology* 30.1 (2017): 270-294.

41. Centres for Disease Control and Prevention (CDC). Smoking and Tobacco Use Fact Sheet Secondhand Smoke (2018).

42. Olivieri M., *et al*. "The risk of respiratory symptoms on allergen exposure increases with increasing specific IgE levels". *Allergy* 71.6 (2016): 859-868.

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